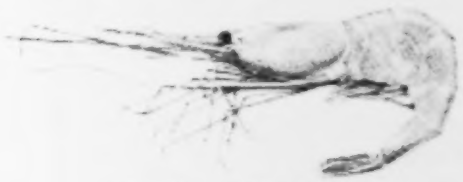


Northern Shrimp (*Pandalus borealis*) - Div. 0B to 3K

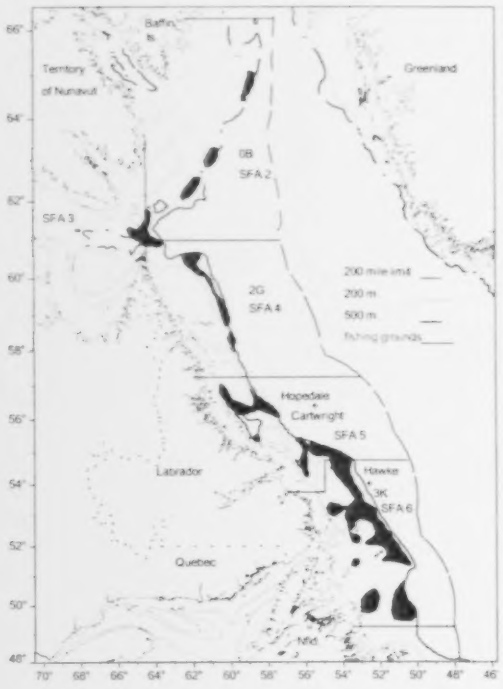
Background

Northern or pink shrimp (Pandalus borealis) are found in the Northwest Atlantic from Davis Strait to the Gulf of Maine, usually in areas where the ocean floor is soft and muddy and where temperatures near the bottom range from about 2 to 6° C. These conditions occur throughout the Newfoundland - Labrador offshore area within a depth range of roughly 150 - 600 m, thus providing a vast area of suitable habitat. The species is the primary cold-water shrimp resource in the north Atlantic.

These shrimp are protandrous hermaphrodites. They first mature as males, mate as males for one to several years and then change sex to spend the rest of their lives as mature females. They are known to live for more than 8 years in some areas. Some northern populations exhibit slower rates of growth and maturation but greater longevity results in larger maximum size.

During the daytime, northern shrimp rest and feed on or near the ocean floor. At night, substantial numbers migrate vertically into the water column, feeding on zooplankton. They are important prey for many species such as Atlantic cod, Greenland and Atlantic halibut, skates, wolffish and harp seals.

Status of the resource for each shrimp fishing area (SFA) is determined by monitoring performance of the fishery within and between years, distribution of fishing effort and the size/age/sex composition of the catches. Also, research trawl surveys since 1995 provide data on stock size and structure for some areas. Using both sources of information, inference can be made on state of the spawning stock (female abundance), potential for future recruitment to the fishery (male abundance) and level of exploitation (catch-to-biomass ratios).



Summary

SFA's 5 and 6 (Divisions 2HJ3K)

- Shrimp biomass/abundance has been stable at a high level in recent years. Distribution is widespread but patchy throughout SFA 5.
- The 1996 year class was shown to be weak within SFA 6 but the 1997 and 1998 year classes appear to be stronger.
- Predation of shrimp remains low in the offshore area.
- Warmer conditions, which have persisted since 1996, could impact growth, survival, sex change and future catch rates.

104-02231/

- Recent catches have had no observable impact on the resource. Removals at the current level will not likely increase the exploitation rate.

- The biological basis previously used to separate SFA's 5 and 6 for assessment purposes appears to be no longer valid. Future stock assessments will consider the implications of treating both areas as a biological unit.

SFA's 2 and 4 (Divisions 0B & 2G)

- Research survey data are either absent (Div. 0B) or incomplete (Div. 2G) in these northern areas. Fishery data from recent years show high catch rates of female shrimp but changes in areas fished within and between years and the mixed fishery with *P. montagui* off Resolution Island increases uncertainty.

- No reliable estimates of the strength of recruiting year classes are available.

- Abundance levels of shrimp predators and competitors are not well known and limited oceanographic data exist for these areas.

- The level of exploitation is uncertain for both areas but is assumed to be low in Div. 2G where recent catches have had no observable impact on the resource. Since only fishery data are available for Div. 0B, the impact of recent catches cannot be evaluated.

- The rationale previously used to separate SFA's 2 and 4 for assessment purposes is no longer valid.

The Fishery

The fishery for northern shrimp on the east coast of Canada began in the mid 1960's in the Gulf of St. Lawrence but it was not until the mid 1970's that an exploratory fishery developed off the coast of Labrador. During the late 1970's and early 1980's, the fishery occurred primarily in the Hopedale and Cartwright Channels and farther north in Davis Strait (Div. 0A). Annual catches increased to 8900 tons in 1981 but then declined to 3100 tons in 1984. Since then, however, catches have steadily increased, the 1999 catch of more than 85,000 tons being the highest reported. This was due to continued high abundance in the traditionally fished areas, the discovery of additional, productive grounds within Div. 0B-3K and Div. 3M and unprecedented high abundance throughout the area of shrimp distribution during the late 1990's.

Each shrimp fishing area within Canadian waters is regulated by total allowable catch (TAC). The preferred species, for which most of the TAC's apply, is *Pandalus borealis*. The striped or Aesop shrimp (*P. montagui*) occur at times as by-catch and, near Resolution Island (SFA's 2, 3 and 4), represent the target species with a separate TAC.

Currently, about 12 large, freezer trawlers utilize the 17 "offshore" shrimp licences. These vessels fish with small-meshed otter trawls fitted with sorting grates that retain the shrimp while minimizing by-catch of other species. Most of the catch is processed on board as either cooked or frozen product. The smallest (industrial) shrimp is frozen raw for processing on shore. The northern shrimp "offshore" fleet requires 100% observer coverage to monitor activity and conduct sampling of the catches. For the first ten years, this was primarily a summer-

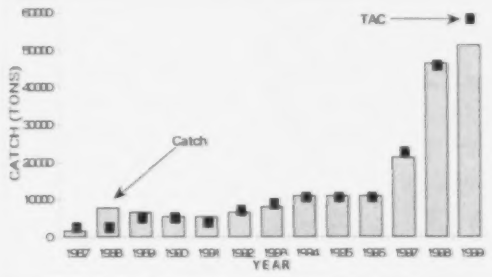
fall fishery but, since the late 1980's, has become a year-round operation.

TAC increases, primarily within Div. 2J3K in 1997, 1998 and 1999, led to the development of an "inshore" fleet component for vessels less than 65 feet. Over 300 licences have been issued since 1997. These smaller vessels operate in approximately the same fishing grounds as the offshore fleet. The "inshore/offshore" designation refers to vessel size, not area fished (i.e. there is no large-scale inshore fishery). The "inshore" fleet also is required to use sorting grates and implement gear modifications to minimize by-catch in the small-meshed otter trawls. The catch is not processed onboard. Rather, the shrimp are landed fresh for processing on shore. A target of 10% observer coverage has been established to monitor activity and conduct sampling of the catches for the "inshore" fleet. Also, 100% dockside monitoring is required. Most fishing by this fleet component occurs during summer and fall.

Hawke Channel + Div. 3K (SFA 6)

Catch and TAC

The shrimp fishery in Hawke Channel + Division 3K began in 1987 when about 1800 tons were caught. In previous years, only a few tons had been reported. Catches increased to more than 7800 tons in 1988 and ranged between 5500 and 8000 tons from 1989 to 1993, inclusive. The annual TAC for the 1994 - 1996 Management Plan was set at 11,050 tons to include several fishing areas within southern Div. 2J and Div. 3K. Catches were 11,000 tons in each of those three years. The TAC for 1997, the first year of the 1997 - 1999 multi-year plan, was raised to 23,100 tons as a first step to increasing the exploitation. TAC's were increased further to 46,200 tons in 1998 and 58,632 tons in 1999. The TAC in 1999 was not reached due to operational problems for



the inshore sector.

Resource Status / Outlook

Catch rates by offshore vessels increased substantially from 1989 to 1995 and have since remained relatively stable at a high level.

Research survey stock size indices also were stable from 1996 to 1999. These observations indicate that shrimp abundance in this area remains high but is no longer increasing. Research data also show that the 1995 year class was weaker than the 1993 and 1994 and that the 1996 year class was the weakest observed within the short time series. However, the 1997 and 1998 year classes appear stronger than those of both 1995 and 1996.

Mean size of females and the size at sex inversion based on commercial sampling

data from offshore vessels have declined since 1996, indicating a possible change in growth within the area. Nevertheless, reproductive potential likely has been maintained in recent years by the high abundance of females.

The overall abundance of shrimp predators in offshore areas of Div. 2J3K remains low. Therefore, predation mortality is low relative to periods of high predator abundance. A recent study concluded that consumption of shrimp by cod in 1983 (when cod were more abundant and shrimp less) was roughly equivalent to commercial catches in SFA 6 in 1998 and 1999.

Warmer environmental conditions after 1995 could affect shrimp growth, survival and sex inversion but the impact is, at present, uncertain.

The resource in this area is currently healthy with high abundance of males and females. Recent increases in TAC's and catches approaching those levels have not resulted in a decline in the stock and catch-to-survey biomass ratios were less than 11% in recent years suggesting low exploitation. The weak 1996 year class will negatively impact recruitment to both the fishery and female biomass over the next few years but the extent of the impact is unknown. The stronger 1997 and 1998 year classes should begin to recruit to the fishery as early as 2000 and serve to buffer the effects of the weak 1996 year class over the next few years.

The fishery in early 2000 is reported to be performing well with preliminary catch rates as high as or higher than those reported for similar periods in previous years.

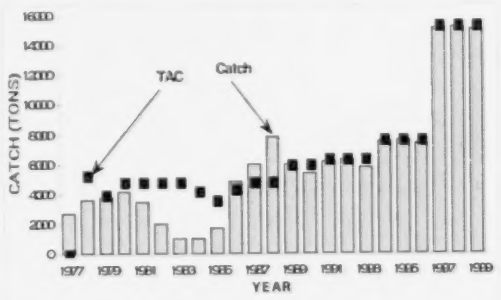
Management Considerations

Removals at the current level (about 50,000 tons) will not likely increase the exploitation rate, despite the potential for a decline in recruitment. The incidence of small shrimp in the catches likely will continue to be problematic for industry with the increasing availability of the 1997 and 1998 year classes.

Hopedale + Cartwright (SFA 5)

Catch and TAC

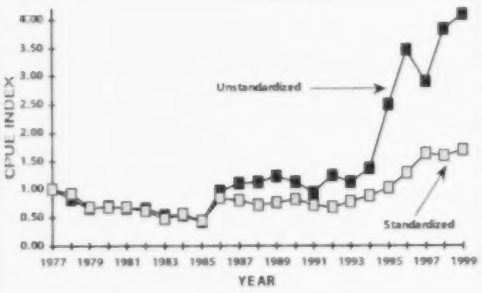
Catches of northern shrimp in Hopedale and Cartwright Channels increased from about 2700 tons in 1977 to 4100 tons in 1980 but declined to 1000 tons in 1983 and 1984. Catches increased again to 7800 tons in 1988 and then stabilized at roughly 6000 tons during the 1989 - 1993 period. TAC's for the 1994 - 1996 management plan were increased by 20% to 7650 tons annually and catches increased, averaging 7500 tons during that period. Annual TAC's for the 1997 - 1999 plan were increased by 100% to 15,300 tons and catches exceeded 15,000 tons in each of the three years.



Resource Status / Outlook

Catch rates from the fishery by offshore vessels increased through the 1990's,

stabilizing at a high level from 1997 to 1999.



Research surveys from 1996 to 1999 produced indices of biomass/abundance with wide confidence intervals, especially in 1996. Distribution of shrimp within this area is patchy and continuous with SFA 6 to the south creating greater uncertainty with respect to trend in the resource. Research sampling data showed that the 1993, 1994 and 1995 year classes dominated the catch of males from 1996 to 1999 but relative year-class strengths are uncertain and there is no recruitment index.

Mean size of females and the size at sex inversion based on commercial sampling data from offshore vessels have declined since 1996, indicating a possible change in growth within the area. Nevertheless, as in SFA 6 to the south, reproductive potential has been maintained in recent years by the high abundance of females.

The overall abundance of shrimp predators in offshore areas of Div. 2HJ remains low. Therefore, predation mortality remains low relative to periods of high predator abundance.

Warmer environmental conditions after 1995 could affect shrimp growth, survival and sex inversion A recent study found a positive correlation between the extent of ice cover and catch rates in the commercial fishery six years later. Reduced ice coverage, observed during the 1996 - 1999 period, could result in catch rates declining gradually or remaining stable over the next several years, assuming predator abundance remains low.

Current status appears favourable from the fishery data, and research surveys indicate a healthy female stock will be maintained in 2000. The extremely high catch rates attained early in 2000 support that view. No decline in the stock was detected with the doubling of the TAC and increased catches within the 1997-1999 Management Plan. Catch-to-survey biomass ratios ranged from 16 to 26% over the past three years. Lacking a recruitment index for this area, prospects beyond 2000 are uncertain.

Management Considerations

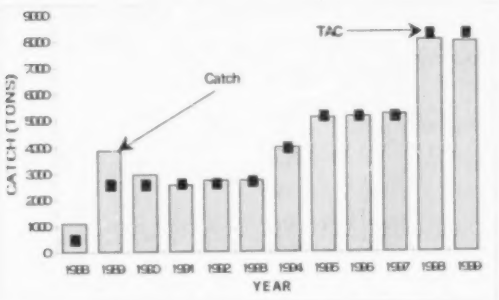
Recent catches have had no observable impact on the stock. Removals at the current level (about 15,000 tons) will not likely increase the exploitation rate.

NAFO Division 2G (SFA 4)

Catch and TAC

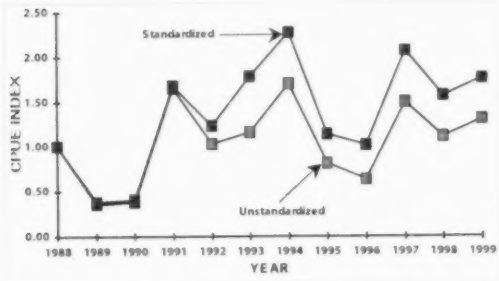
Catches increased from about 1100 tons in 1988 to 3800 tons in 1989 and remained within the 2500 - 3000 ton range up to and including 1993. The 1994 catch increased to about 4000 tons with an increase in TAC in the first year of the 1994 - 1996 Management Plan. A further increase in TAC to 5200 tons for 1995 and 1996 resulted in catches of about 5100 tons in both years. The TAC of 5200 tons was maintained for 1997 and catch was estimated at that level. TAC's for 1998 and 1999 were increased by 60% to 8320 tons. Further, part (70%) of the increase was applied to the area south of 60^0 N. Catches

in both years were estimated at approximately 8000 tons.



Resource Status / Outlook

Commercial catch rates fluctuated without trend at a high level during the 1990's and there was no significant difference from 1997 to 1999. This indicates some stability in the resource.



Biomass/abundance indices from 1996, 1997 and 1999 were imprecise with wide confidence intervals and survey coverage has been poor. Therefore, trend in stock size is uncertain from surveys and results must be interpreted cautiously. Despite uncertainties, data from both research and the commercial fishery indicate continued high abundance of females in 1999 and exploitation less than 20%.

Declines in mean size of females and size at sex inversion have been observed but the causes are unclear due to uncertainty in stock structure and changes in areas fished.

Current status is positive with both fishery and research data indicating a healthy spawning stock. However, prospects beyond 2000 are uncertain in the absence of a recruitment index.

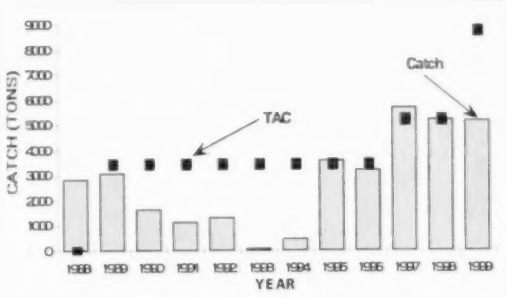
Management Considerations

Recent catches have had no observable impact on the stock. There is no scientific basis for a change in the TAC of 8320 tons.

NAFO Division 0B (SFA 2)

Catch and TAC

Catches increased from about 2800 tons in 1988 to 3000 tons in 1989 but subsequently declined to 100 tons in 1993. In 1994, catch remained low at less than 500 tons but increased substantially to about 3600 and 3200 tons in 1995 and 1996, respectively, and averaged 5300 tons from 1997 to 1999. TAC's remained at 3500 tons from 1989 to 1996 but were increased experimentally to 5250 tons for the 1997 - 1999 multi-year management plan. An additional quota of 3500 tons was implemented for an experimental fishery north of 63^0 N in 1999 but resulted in a catch of just over 100 tons.



Resource Status / Outlook

Catch rates increased from 1993 to 1998 and declined in 1999 to the level observed in 1997. The period of increase is associated with a southward shift in fishing effort to the area east of Resolution Island. The fishery in this area is directed at both *Pandalus borealis* and *P. montagui*. These factors create uncertainty in the CPUE series as an indicator of trend in the stock.

Knowledge of the biology, distribution, abundance and exploitation of shrimp off Baffin Island is lacking in the absence of a time series of research trawl surveys. Fishery data alone cannot be interpreted as an indication of trend in the stock.

Declines in mean size of females and size at sex inversion have been observed but the causes are unclear due to uncertainty in stock structure and changes in areas fished.

Current status is uncertain in the absence of data related to stock distribution, delineation and level of exploitation. Prospects beyond 2000 are unknown.

Management Considerations

It is not possible to evaluate the impact of recent catches. The catch limits imposed for 1999 can be continued in 2000.

Industry Perspective

Both industry and science perspectives on northern shrimp continue to portray a healthy resource. Industry observes that catch rates continue to be excellent over a broad area. Smaller shrimp are being seen in recent years which may reflect strong recruitment but could also indicate slower growth due to environmental changes, population density, available feed, etc. Industry believes that the stock is well managed with respect to exploitation level and avoidance of by-catch and discards.

It seems that in SFA 6, and to a lesser extent in SFA 5, knowledge of the stock is such that science and industry can reach consensus about the status of the resource. In SFA 2 off Baffin Island, knowledge of the resource is anecdotal at best, given that there is no science survey work conducted. Survey coverage in SFA 4 has been incomplete resulting in imprecise stock size indices. Industry views this matter with great concern.

Northern shrimp is now worth over $300 million to the Canadian offshore and inshore fishing industry. Canada is the largest producer of northern shrimp, supplying over one-third the global supply. Access fees for the northern shrimp sector exceed $3 million annually. Industry has emphasized that apart from access to a multi-species survey, only a couple of scientists and technicians are dedicated to assessing this critically important resource. Industry considers that priorities clearly need to be reviewed; it is unacceptable to proceed with a 'best guess' approach to assessment of northern shrimp.

The Nunavut Wildlife Management Board, the Department of Sustainable Development, Government of Nunavut and the

communities of Canada's newest territory are very frustrated with the lack of appropriate scientific research pertaining to the shrimp resource in waters near Nunavut. Shrimp (*Pandalus borealis* and *P. montagui*) are important commercial species exploited in Nunavut. Scientific research effort has been lacking during the past two decades. The last comprehensive scientific survey for shrimp (*P. montagui*) was in 1982.

Shrimp Fishing Area Boundaries

The foregoing assessment of the status of northern shrimp resources included a review of the basis for the shrimp fishing area boundaries that have been in effect since 1994. The findings of the review provide a direction for future assessments from both science and management perspectives.

Rationale in 1993 for SFA's 5 and 6:

- Hawke Channel and fishing areas within Div. 3K were combined (SFA 6) based on evidence that shrimp over these grounds belonged to a biological unit.
- Rates of growth and maturation were more variable within SFA 6 compared to the relatively stable conditions observed in the Hopedale and Cartwright Channels (SFA 5).
- Hopedale and Cartwright Channels were the only areas fished every year since the fishery began in the mid-1970's.
- Shrimp growth rates and timing of maturity stages were shown to be similar in Hopedale and Cartwright Channels.
- The boundary between SFA's 5 and 6 (53^0 45' N east to 55^0 W, then north to 54^0 45' N and east to the 200 mile limit) was based on historical commercial fishing records that showed a clear separation of fishing grounds between Cartwright Channel to the north and Hawke Channel to the south.

Current situation:

- Research survey samples from Hopedale and Cartwright Channels during 1996 - 1999 reflect a change in growth and maturation in this area and/or a northward expansion of the resource from Hawke Channel and Division 3K. The age composition of shrimp in the former area could only be resolved using a growth model described previously for the latter.
- There has been no separation of fishing grounds along the shelf slope between Cartwright and Hawke Channels since 1994. Fishing effort along this edge has been extensive in both SFA's for the past six years. (see map on page 1)

Assessment/management implications:

- There is no basis for maintaining SFA's 5 and 6 as separate biological units. Future assessments will address the implications of assessing shrimp in Div. 2HJ3K as a single unit.
- The existing northern boundary of SFA 5 (57^0 15' N) can be modified to conform to the actual NAFO boundary dividing Divisions 2G and 2H (57^0 40' N). This will have no impact on past catch/effort statistics because no significant fishery has ever taken place in this area.

Rationale in 1993 for SFA's 2, 3 and 4:

- Div. 2G (SFA 4) was considered to be a zone of transition from the large, long-

lived animals found in Div. 0B (SFA 2) to sizes and ages typically found in Hopedale and Cartwright Channels off the mid-Labrador coast. No area of separation could be identified.

- It was considered that Div. 0B (SFA 2) should be treated separately because of the uncertainty surrounding the status of the resource.

- Longevity of shrimp was greater in Div. 0B; sex change occurred two years later than in areas farther south and females attained very large sizes.

- Deep water and strong outflow from Hudson Strait physically separated the area from the southern grounds.

- SFA 3 was established west of 64^0 30' W and east of 70^0 W to designate a fishing area for concentrations of *Pandalus montagui* which, up to 1994, were located west of Resolution Island in Hudson Strait and west of Port Burwell in Ungava Bay.

- There was no fishery for *Pandalus borealis* in SFA 3 prior to 1995.

Current situation:

- There is still uncertainty concerning stock structure and boundaries within SFA's 2, 3 and 4 for both *P. borealis* and *P. montagui*. Uncertainty will continue in the absence of a series of research trawl surveys.

- The physical separation of fishing grounds did not continue after 1994. An area east of Resolution Island has been fished extensively for both species since 1995 and the grounds overlap the three SFA's. This has caused many problems for catch/SFA/species reporting and, consequently, for quota monitoring. (see map on page 1)

Assessment/management implications:

- The current boundaries separating SFA's 2, 3 and 4 are not effective for addressing differences due to species, stocks or fishing grounds and should be reviewed.

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Catch	Increased from about 11,000 tons during 1994 -1996 to over 50,000 in 1999 due to incremental TAC increases. With few exceptions the TAC's were reached each year up to 1998. The quota was not reached in 1999 due to operational reasons.
Effort	Increased from 1996 to 1999 with the increases in TAC. New effort primarily due to vessels < 65 feet. Some double trawling (< 5% of offshore effort since 1997).
By Catch	The mandatory use of sorting grates on shrimp vessels and low groundfish abundance in this area minimize the bycatch. Fishermen avoid situations where there is a potential bycatch problem. Greenland halibut bycatch was estimated to be less than 2 % per age class.

INDEX	OBSERVATION	INTERPRETATION	EVALUATION
FISHERY DATA			
CPUE index	Increased for the offshore fleet up to 1995 and has since remained relatively stable at a high level. No CPUE index for the inshore fleet which took 66% of the catch in 99.	Reflects an increase in the resource up to the mid 1990's, remaining at a high level since.	+
Spatial pattern	Eastward expansion in effort by offshore vessels in early 1990's.	Reflects discovery of high shrimp concentrations along the shelf slope during exploratory fishing in 1992 and 93, areas previously thought unproductive.	+
Temporal pattern	A winter-spring fishery for the offshore fleet and a summer-fall fishery for the inshore fleet.	High concentrations of shrimp are available throughout the year.	+
Male abundance	The 1991 year class dominated the catch of males in 1995 and 96. The 93 year class dominated in 97 and 98, and the 94 year class in 99.	Good recruitment of year classes produced in the early 90's resulted in high catch rates of males since 1995.	+
Female abundance	Catch rates of the female component increased up to 1995 and have since remained relatively stable, at a high level.	Continued good recruitment since the mid-to-late 1980's explains the increase in spawning stock through the 90's. Spawning component remains healthy.	+
Sex inversion	The mean size of females and the median size at sex change have declined since 1996. These data are from the offshore vessels only.	Likely reflects a change in growth and size at sex change, but there is uncertainty as to whether this is representative of the entire SFA.	?
RESEARCH DATA			
Biomass/ abundance index	The lower 95% confidence intervals for the biomass/abundance indices were relatively stable and averaged 426,000 tons/100 billion animals during the 1996 - 1999 period.	Biomass/abundance stable at a high level.	+
Spatial pattern	Widely distributed throughout the management area. Distribution patterns vary between years.	Broader distribution in the 1990's compared to the 1980's, because of higher stock size.	+
Recruitment (male age structure)	The 1995 year class was weaker than the 93 and 94. The 96 was the weakest observed in the short time series. The 1997 & 98 year classes appear stronger than 95 and 96.	Biomass of males could decline in 2000/2001 due to the weak 1996 year class but increase thereafter.	?
Spawning stock (females)	Relatively stable from 1996 to 98. Possible increase in 1999 survey due to female portion of the 1994 year class and full recruitment of the 93 year class as females.	Female biomass/abundance will be maintained in 2000 by the 93 and 94 year classes but could decline thereafter with the weak 96 year class.	+
OTHER FACTORS			
Predation	Overall abundance of predators remains low in the offshore areas. Cod consumption in 1983 roughly equivalent to 1998/99 commercial shrimp catches.	Predation mortality is low relative to periods of high predator abundance.	+
Environment	After 1995, temperatures have increased and this could impact growth, survival and sex change.	Uncertainty.	?
Industry perspectives	Offshore catch rates over a broad area in Jan/Feb 2000 are among the highest observed, but sizes are reported to be small.	The resource is perceived to be healthy by both inshore and offshore sectors.	+
ASSESSMENT			
Exploitation Rate	Ratios of nominal catch to survey biomass index (lower confidence intervals) have been <11% for the past 4 years.	Catchability of the survey gear is believed to be <1. Therefore, exploitation rate likely has been low.	+

Stock Status	**Current status: High biomass/abundance of male and female components.**	+
	Prospects: Over the next few years, residual female stock and stronger 97 + 98 year classes should buffer weak 96 year class.	+

Concerns for current status/future prospects −

Uncertainty regarding index quality or impact ?

Positive evaluation +

Recent catches have had no observable impact on the stock. Removals at the current level will not likely increase the exploitation rate.

Catch	Increased from about 7500 tons during 1994-96 to 15,000 from 1997-99 due to TAC increase. With few exceptions, TAC's were reached each year since 1986.
Effort	Increased during 1997-99 from the 1996 level with the increase in TAC. Additional effort primarily due to existing offshore fleet. Some indication of double trawling (< 10% of total effort each year since 1997).
By Catch	The mandatory use of sorting grates on shrimp vessels and low groundfish abundance in this area minimize the bycatch. Fishermen avoid situations where there is a potential bycatch problem. Greenland halibut bycatch was estimated to be less than 2 % per age class.

INDEX	OBSERVATION	INTERPRETATION	EVALUATION
FISHERY DATA			
CPUE index	Increased for offshore fleet during the 1990's, stabilizing from 97 to 99.	Reflects an increase in the resource up to about 1997, remaining at a high level since.	✚
Spatial pattern	The offshore component of fishery expanded to shelf edge.	Reflects discovery of high concentrations of shrimp along shelf slope during exploratory fishing in 1992 and 93, areas previously thought unproductive.	✚
Temporal pattern	A winter-spring fishery for the offshore fleet since 1995; previously a summer-fall fishery. Inshore vessels fish during summer-fall.	High concentrations of shrimp available throughout the year.	✚
Male abundance	Catch rates of males increased during the1990's. The 1991 year class dominated the males in 1995 and 96, the 93 year class in 97 and 98, and the 94 year class in 99.	Good recruitment of year classes produced in the early 1990's resulted in high catch rates of males over the past several years.	✚
Female abundance	Catch rates of females increased from about 1993 to 97 and stabilized in 1998 and 99.	Continued good recruitment since late 1980's is responsible for the increase in spawning stock throughout the 1990's. Spawning component remains healthy.	✚
Sex inversion	The mean size of females and the median size at sex change have declined since 1996. These data are from the offshore vessels only.	Likely reflects a change in growth and size at sex change.	?
RESEARCH DATA			
Biomass/ abundance index	Estimates declined from 1996 - 98 and increased in 99. Broad 95% confidence intervals in this area especially in 1996.	Greater uncertainty because distribution is continuous with SFA 6 but more patchy in the northern channels.	?
Spatial pattern	Shrimp are distributed widely throughout the management area but very high catches occur in some locations.	With current low survey coverage and relationship with southern area, results must be interpreted cautiously.	?
Recruitment (male age structure)	Males dominated by the 93 year class in 1996 and 97 surveys. The 94 year class was prominent in the 1998 survey and the 94 and 95 in the 1999. No recruitment estimate.	Most of the 94 year class will recruit to the female group in 2000.	?
Spawning stock (females)	Females in 1999 were composed of year classes produced prior to 1994 but most were assumed to belong to the 93 year class.	Female biomass/abundance will be maintained in 2000 by the 93 and 94 year classes.	✚
OTHER FACTORS			
Predation	Abundance of known predators in the offshore areas such as cod, redfish, skate and American plaice remains low.	Predation mortality remains low relative to periods of high predator abundance.	✚
Environment	Positive correlation was observed between ice cover and CPUEs six years later and reduced ice coverage during the 96 – 99 period was observed.	Catch rates could decline gradually or remain stable over the next several years, assuming predator abundance remains low.	?
Industry perspectives	Catch rates from the 2000 fishery over a broad area for Jan/Feb are reported to be higher than for the same months in previous years.	Stock remains healthy.	✚
ASSESSMENT			
Exploitation Rate	Ratio of nominal catch to survey biomass index (lower confidence interval) has been 16 - 26% for the past three years.	Catchability of the survey gear is believed to be <1. Therefore, exploitation rate likely has been <26% in recent years.	✚

Stock Status	**Current status: Appears favourable from the fishery data. Survey data indicate healthy female component.**	✚
	Prospects: Lack of recruitment index (ages 1 & 2) does not allow projection.	?

Concerns for current status/future prospects −

Uncertainty regarding index quality or impact ?

Positive evaluation ✚

Recent catches have had no observable impact on the stock. Removals at the current level will not likely increase the exploitation rate.

Catch	Increased from about 5200 tons during 1995-97 to 8000 in 1998 and 1999 due to TAC increase. TAC's, with few minor exceptions, have been reached each year since 1988. Some *P. montagui* in the northwest.
Effort	Increased from 1994 to 1996 and has fluctuated since. Incidence of double trawling since 1997 low based on observer data.
By Catch	The mandatory use of sorting grates on shrimp vessels and low groundfish abundance in this area minimize the bycatch. Fishermen avoid situations where there is a potential bycatch problem. Greenland halibut bycatch was estimated to be less than 2 % per age class.

INDEX	OBSERVATION	INTERPRETATION	EVALUATION
FISHERY DATA			
CPUE index	Fluctuated without trend since 1991. No significant difference from 1997 to 99.	Reflects relative stability in the resource since 1997.	✚
Spatial pattern	Increased effort south of 60° N in 1998 and 99 due to a separate quota for the area.	Reflects the existence of high concentrations of shrimp along the shelf slope, outside the area fished during most of the 1990's.	✚
Temporal pattern	A summer-fall fishery. Ice covered in winter.	High shrimp concentrations available throughout the open season.	✚
Male abundance	The proportion of males in the catch varies between years and tends to be less important than observed in management areas to the south.	Fishery does not occur in areas where males are abundant.	✚
Female abundance	Catch rates of females stable at a high level from 1997 - 99.	Despite the fishery targeting large females, the spawning stock appears healthy.	✚
Sex inversion	Average length of females and median size at sex inversion have declined since 1991.	Reasons for the decline are unclear, however, one factor may be the shift of effort to south of 60°N.	?
RESEARCH DATA			
Biomass/ abundance index	Biomass/abundance estimates for 1997 and 99 from depths >200 m were similar and higher than in 96. Survey coverage has been poor and stock estimates are imprecise.	Trend in stock biomass/abundance uncertain.	?
Spatial pattern	Areas of high density occur at some locations throughout the area.	With current low survey coverage, results must be interpreted cautiously.	?
Recruitment (male age structure)	Survey in 1996 dominated by males of the 1991 and 92 year classes, 1997 by the 92 and 93 year classes and 1999 by the 94 and 95 year classes. No recruitment index.	Most of the 94 year class will recruit to the female group in 2000.	?
Spawning stock (females)	At least 3 year classes of females present during the 1996, 97 and 99 surveys. Indications of increase in biomass/abundance since 1996.	Spawning stock appears healthy although the mixing of stocks with different growth rates and maturity schedules in this area makes interpretation difficult.	?
OTHER FACTORS			
Predation	Abundance of predators/competitors of shrimp not well known in this area.	No inference for predation mortality.	**None**
Environment	Limited oceanographic data for this area.	Cannot be evaluated.	**None**
Industry perspectives	Industry questions the biological basis for the boundaries that separate SFA's 2,3 and 4.	Reflects the uncertainty in stock distribution.	?
ASSESSMENT			
Exploitation Rate	Ratios of nominal catch to survey biomass index (lower confidence interval) have been less than 20% for each year surveys were conducted.	Considering survey coverage is incomplete and catchability of the survey gear is believed to be <1, exploitation rate is assumed to be low.	✚

Stock Status	**Current Status: Fishery data indicate a high abundance of females. The research data indicate a healthy spawning stock.**	✚
	Prospects: Lack of recruitment index (ages 1 & 2) does not allow projection.	?

Concerns for current status/future prospects −
Uncertainty regarding index quality or impact ?
Positive evaluation ✚

Recent catches have had no observable impact on the stock.

Catch	Increased from about 3200 tons in 1996 to 5300 from 1997 to 1999 due to TAC increase. TAC's attained from 1995 - 1998. Additional quota north of 63° N in 1999 (3500 tons) resulted in an additional catch of only 100 tons. Fishery mixed with *P. montagui* in the southwest.
Effort	Increased from 1993 to 1995, stabilizing thereafter. "Target species" is, at times, uncertain. Double trawling since 1996 estimated at < 3% of total effort each year.
By Catch	Small fish (especially redfish) are retained by the small-meshed gear from time to time in this area. However, the mandatory use of sorting grates on shrimp vessels minimizes bycatch. In practice, fishermen avoid situations where there is a potential bycatch problem.

INDEX	OBSERVATION	INTERPRETATION	EVALUATION
FISHERY DATA			
CPUE index	Increased from1993 to 1998 and declined in 1999 to the level observed in 1997.	CPUE increase associated with shift to southern area since 95. Mixed species fishery introduces uncertainty in CPUE as an indicator of trend in stock size.	?
Spatial pattern	Effort shifted from north to south in the early 1990's. Southwest fished extensively since 1995, targeting dense concentrations of *P. montagui/borealis* east of Resolution Island.	Concentrations of *P. borealis* still exist in the northeastern area but were not sufficient to attract significant effort in 1999.	?
Temporal pattern	A summer-fall fishery. Ice covered in winter and spring.	Distribution unknown for much of the year.	?
Male abundance	Catch rates of the male component of the catch increased with the southward shift in effort.	Population structure uncertain.	?
Female abundance	Catch rates of females also increased with the southward shift in effort.	Population structure uncertain.	?
Sex inversion	The mean size of females and median size at sex change declined since 1996.	Population structure and boundaries uncertain.	?
RESEARCH DATA			
Biomass/ abundance index	**No Data**		**No Evaluation Possible**
Spatial pattern			
Recruitment (male age structure)			
Spawning stock (females)			
OTHER FACTORS			
Predation	Abundance of predators/competitors of shrimp not well known in this area.	No inference for predation mortality.	None
Environment	Limited oceanographic data.	Cannot be evaluated.	None
Industry perspectives	Industry questions the biological basis for boundaries that separate SFA's 2, 3 and 4 and notes the absence of research surveys in this area. CPUE high over a large area.	Reflects the uncertainty in stock distribution/delineation but industry considers that the stock is healthy.	✚
ASSESSMENT			
Exploitation Rate	No biomass indices available for this area.	Exploitation rate is unknown.	None

Stock Status	**Current Status: Uncertainty in understanding stock distribution, delineation and exploitation level due to lack of data.**	?
	Prospects: Unknown.	?

Concerns for current status/future prospects −

Uncertainty regarding index quality or impact ?

Positive evaluation ✚

Difficult to evaluate the impact of recent catches.

SUMMARY OF ASSESSMENTS

INDEX	EVALUATION			
	HAWKE + 3K (SFA 6)	HOPE + CART (SFA 5)	DIV. 2G (SFA 4)	DIV. 0B (SFA 2)
FISHERY DATA				
CPUE index	+	+	+	?
Spatial pattern	+	+	+	?
Temporal pattern	+	+	+	?
Male abundance	+	+	+	?
Female abundance	+	+	+	?
Sex inversion	?	?	?	?
RESEARCH DATA				
Biomass/ abundance index	+	?	?	No Evaluation Possible
Spatial pattern	+	?	?	
Recruitment (male age structure)	?	?	?	
Spawning stock (females)	+	+	?	
OTHER FACTORS				
Predation	+	+	None	None
Environment	?	?	None	None
Industry perspectives	+	+	?	+
ASSESSMENT				
Exploitation Rate	+	+	+	None
Stock Status				
Current Status	+	+	+	?
Prospects	+	?	?	?

Concerns for current status/future prospects −

Uncertainty regarding index quality or impact ?

Positive evaluation +